UBFC UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

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femto-st SCIENCES & TECHNOLOGIES

école doctorale **sciences pour l'ingénieur et microtechniques** SPIM

Electron-induced on-surface chemistry

Host institution : **Université de Bourgogne Franche-Comté**

Laboratory : **FEMTO-ST Institute**

Domain : *Physics*

Doctoral school : Sciences physiques pour l'ingénieur et microtechniques - SPIM - ED 37

Description of the PhD thesis:

Over the past decade, on-surface fabrication of organic nanostructures has been widely investigated for the development of molecular electronics, nanomachines, and new materials. We have developed toolboxes to obtain extended supramolecular networks on surfaces of metal, insulators or semi-conductors (see Figure). Recently, we introduced a new strategy to selectively obtain alkyl oligomers by on-surface tandem radical chemistry (manuscript submitted October 2017). Using the electrons between the surface and the tip of a scanning tunneling microscope, a sequential process can be triggered electronically.

a) b)

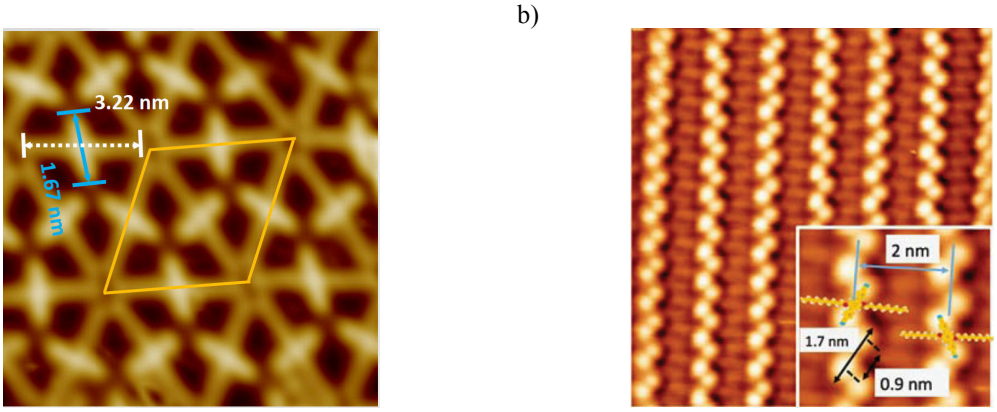

Figure: STM images of 2D extended networks obtained by deposition of the same molecule on a) a Cu(111) surface (Vs= -1.1 V, I= 1.01 nA, 110 K, 10×10 nm^2) and b) a Si(111)-B surface (Vs= +1.7 V, I= 0.01 nA, 110 K, 13×13 nm^2).

We highlight adsorbate-induced resonance state as a key-parameter of the initiation step. This single-electron transfer event both facilitates access to reactive radical species under exceptionally mild conditions and can effectively 'switch on' a tandem sequence.

Due to the unique on-surface space confinement, **the PhD student will deepen our strategy and develop new methods (STM induced, LEED induced reactions etc.) to control the formation of linear oligomers that are not usually observed by solution-processed synthesis.** This approach constitutes an attractive strategy to the development of new free radical polymerisations and molecularly-precise nanolithography based on surface localized reactions. The radical polymerisation will be performed on metal, carbon-based and silicon surfaces.

Environment :

The Nanosciences group combines skills in synthesis chemistry (F. Chérioux), in surface science and in scanning probe microscopy (F. Palmino, Y. Makoudi, W. Hourani, D. Teyssieux and J. Jeannoutot). By merging our interdisciplinary skills, we study the basic mechanisms of supramolecular self-assemblies on silicon surfaces. We distinguish ourselves from competitors who work on noble metals or carbon surfaces because we wish that our organic-semiconductor hybrid systems are compatible with micro-technologies based on silicon wafers. Our group possesses all near-field scanning probe microscopies to characterize the molecular networks: two Omicron UHV scanning tunneling microscopy (STM) within a temperature range from 100 to 600 K, one UHV QPLUS, one atomic force microscopy (AFM and derivated technics) and STM under ambient conditions. We are internationally recognized in these domains. The group is located at Montbéliard.

Additional information

This work (travels, extra costs etc.) will be supported by funding of the French national agency for Science (http://projects.femto-st.fr/projet-organiso/). Strong collaborations with ENS Paris (for theory and simulation, http://www.chimie.ens.fr/?q=pasteur) and ChimieParisTech (for radical polymerisation, http://ircp.cnrs.fr/spip.php?article93) are already established.

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